Multivalent Prototyping and its Value for 5-5-5

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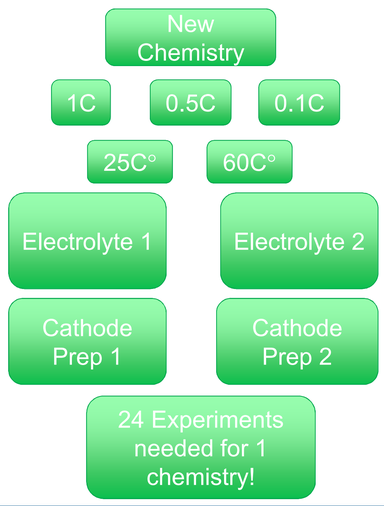
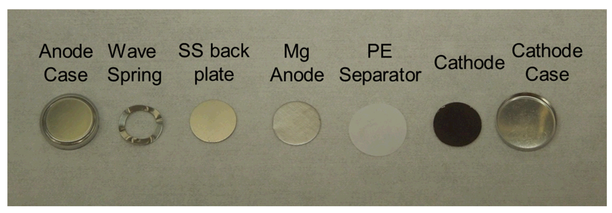
Motivation

Cell evaluation requires full assemblies. Many factors can affect the performance of the cell. This can lead to a lot of experiments. Thus, a fast, stable platform is needed to evaluate permutations.



Approach



Assemble standard 2032 coincells

This affords high throughput with great control and reproducibility!

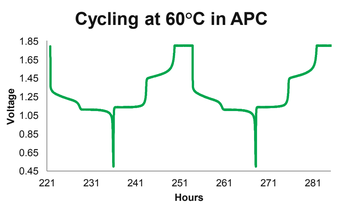
How do we prototype

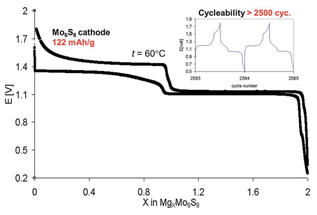
Place in temperature controlled environment

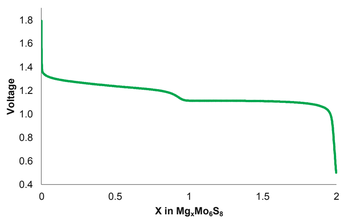
Control with tester

Major Accomplishments

Replication of Best in Class Literature



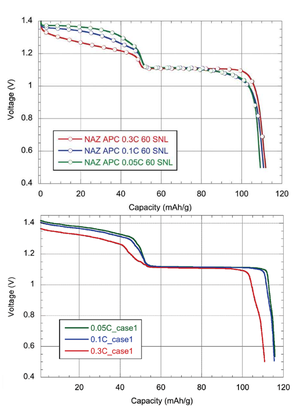




Coin cell prototypes agree with performance in literature.

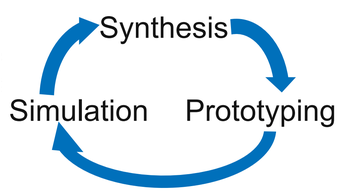
Maximum theoretical capacity achieved.

Preliminary Simulation Results

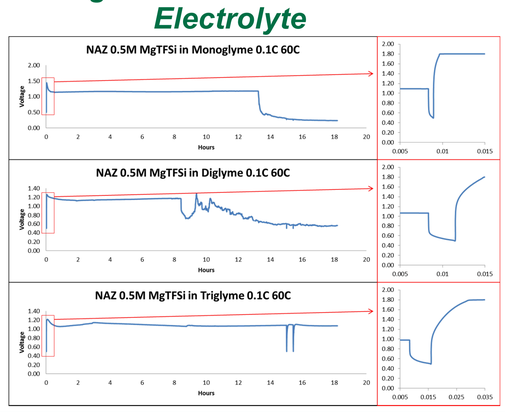


Initial results show good agreement.

More collaboration needed to improve simulation.

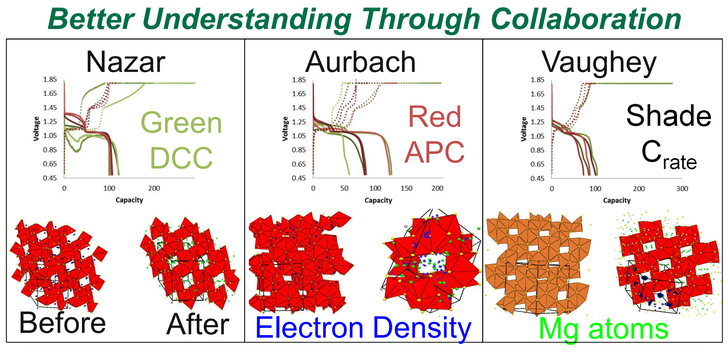


Evaluating the Performance of Current Electrolyte



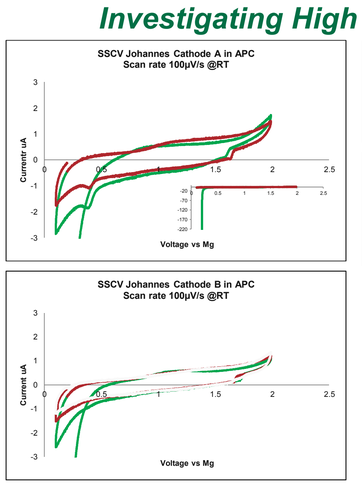
No performance with this electrolyte against a known working cathode

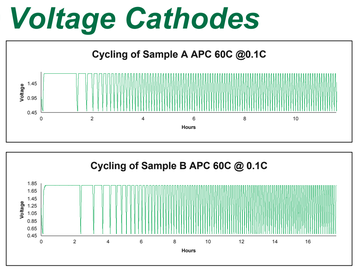
Better Understanding Through Collaboration



C$_{rate}$, Temperature, and electrolyte were tested against the three cathode preps. Prototyping allowed for the rapid and complete characterization of these materials

Investigating High Voltage Cathodes

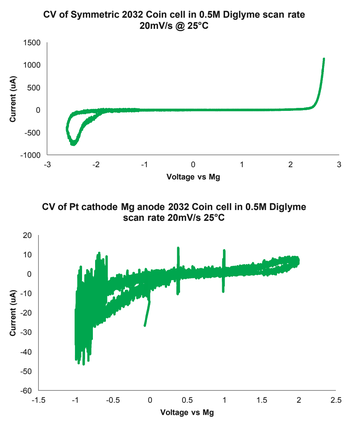


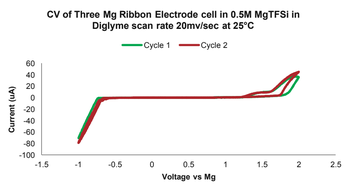


What is going on?

- OCV 1.4V
- Large reduction at start of CV
- NO cycling behavior

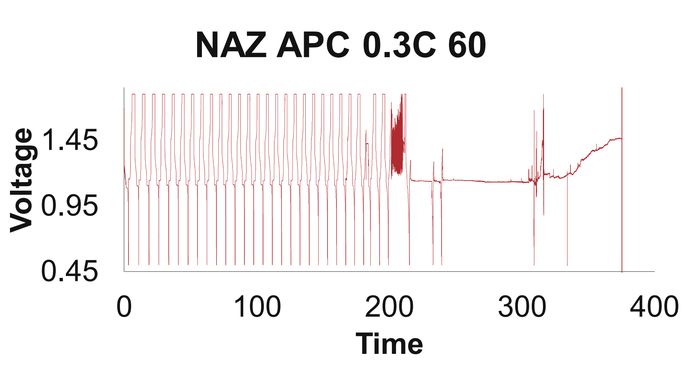
Coincell testing of Electrolyte



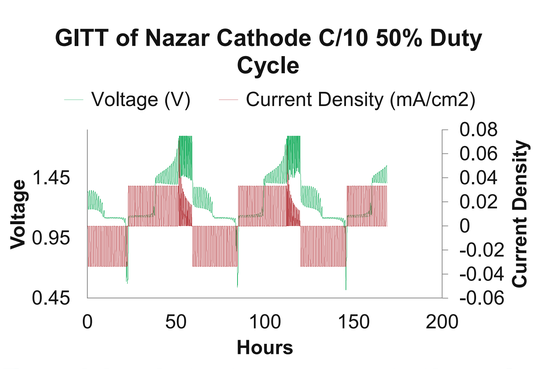


- 2V overpotential needed
- Asymmetric cell with no activity
- 3 electrode configuration shows activity

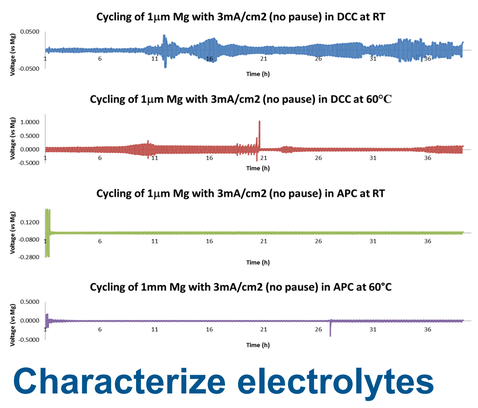
Future Directions and Impact



Investigate cell death



Provide data to computational groups to improve fit



Characterize electrolytes with Zavadil Group

Provide Feedback to synthetic and electrolyte groups to develop compatible chemistries for high voltage cathodes

Key Take-Away

The Mg^{2+}/Mo_6S_8 system may not fulfill JCESR's aggressive requirements

Highlights the electrode/electrolyte compatibility challenge

Establishes the value of prototyping for meeting the 5-5-5 plan

Relevant publications:

Yoo, H. D.; Shterenberg, I.; Gofer, Y.; Gershinsky, G.; Pour, N.; Aurbach, D., Mg rechargeable batteries: an on-going challenge. *Energy & Environmental Science* **2013,** *6* (8), 2265-2279

Synthesis of Mo_6S_8 Cathode and its Subsequent Performance in a Mg ion Battery (Manuscript out)

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